Brazos River Authority

Brazos River Authority
Special Briefing
for
Brazos Basin BBASC

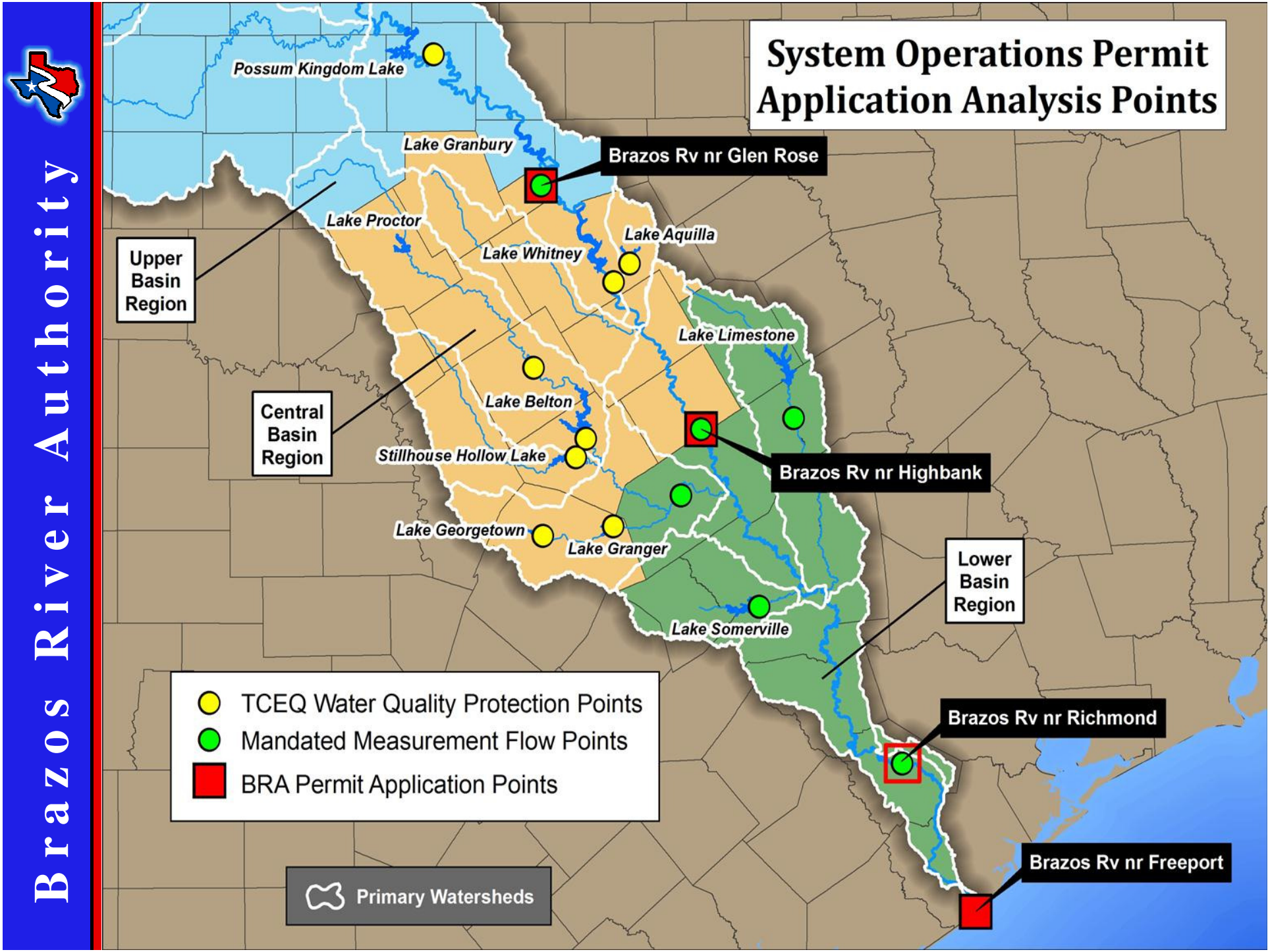
System Operation Permit
vs.
SB3

Brazos River Authority

System Operation Permit Environmental Flows

- **Permit Application**
  - **3 Measurement Points**
    - **Lyons Method**

- **Draft Permit Special Conditions (following TPWD Negotiations)**
  - **6 Primary Measurement Points**
    - **Flow requirements developed using SB3 flow-regime methodology**
    - **Predecessor to the HEFR model**
    - **Instream Flow studies (in cooperation with TIFP)**
  - **8 Water Quality Protection Points**
    - **7Q2**
    - **Monitoring Studies (in cooperation with TPWD)**


Brazos River Authority
System Operations Permit Application Analysis Points
Possum Kingdom Lake
Lake Granbury
Brazos Rv nr Glen Rose
Lake Proctor
Lake Aquilla
Lake Whitney
Upper Basin Region
Lake Limestone
Central Basin Region
Lake Belton
Stillhouse Hollow Lake
Brazos Rv nr Highbank
Lake Georgetown
Lake Granger
Lower Basin Region
Lake Somerville
Brazos Rv nr Richmond
TCEQ Water Quality Protection Points
Mandated Measurement Flow Points
BRA Permit Application Points
Brazos Rv nr Freeport
Primary Watersheds

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HFP's
System Operation Permit Draft
(Glen Rose Gage)

Pulse Flows (ac-ft)	BRAZOS RIVER NEAR GLEN ROSE - USGS #08091000			
Hydrologic Condition	Winter	Spring	Summer	Fall
Dry	2,329.6	3,208.3	2,617.2	2,211.6
Average	7,325.0	14,915.7	7,265.5	7,565.0
Wet	31,220.8	36,144.8	33,064.5	28,682.0

Peak Flows (cfs)	BRAZOS RIVER NEAR GLEN ROSE - USGS #08091000			
Hydrologic Condition	Winter	Spring	Summer	Fall
Dry	403	466	394	347
Average	1,120	2,070	1,320	1,040
Wet	4,945	5,265	4,370	3,525

Pulse Flow Schedule (days/# of events) — BRAZOS RIVER NEAR GLEN ROSE - USGS #08091000

	Winter		Spring		Summer		Fall	
Hydrologic Condition	Dura*	Freq**	Dura	Freq	Dura	Freq	Dura	Freq
Dry	6	2	4	3	4	2	4	2
Average	7	2	6	2	6	2	7	1
Wet	13	1	10	2	11	1	11	1

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Permit Instream Flow at Glen Rose

Overbank Events												
High Flow Pulses	Qp: 4,945 cfs Frequency 1 per season Volume is 31,220.8 AF Duration is 13 days			Qp: 5,265 cfs Frequency 2 per season Volume is 36,144.8 AF Duration is 10 days			Qp: 4,370 cfs Frequency 1 per season Volume is 33,064.5 AF Duration is 11 days			Qp: 3,525 cfs Frequency 1 per season Volume is 28,682.0 AF Duration is 11 days		
	Qp: 1,120 cfs Frequency 2 per season Volume is 7,325.0 AF Duration is 7 days			Qp: 2,070 cfs Frequency 2 per season Volume is 14,915.7 AF Duration is 6 days			Qp: 1,320 cfs Frequency 2 per season Volume is 7,265.5 AF Duration is 6 days			Qp: 1,040 cfs Frequency 1 per season Volume is 7,565.0 AF Duration is 7 days		
	Qp: 403 cfs Frequency 2 per season Volume is 2,329.6 AF Duration is 6 days			Qp: 466 cfs Frequency 3 per season Volume is 3,208.3 AF Duration is 4 days			Qp: 394 cfs Frequency 2 per season Volume is 2,617.2 AF Duration is 6 days			Qp: 347 Frequency 2 per season Volume is 2,211.6 AF Duration is 4 days		
Base Flows (cfs)	234.0			292.8			249.5			332.0		
	92.0			138.0			101.5			150.0		
	39.0			45.0			33.3			62.0		
Subsistence Flows (cfs)	15.3			15.3			15.3			15.3		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	Winter			Spring			Summer			Fall		

Hydrologic Levels
High (75th %ile)
Medium (50th %ile)
Low (25th %ile)

Pulse volumes are in units of acre-feet and durations are in days.

Pulse events are terminated when the volume and duration criteria are met.

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BBEST Recommendation at Glen Rose

Overbank Events	Qp: 33,600 cfs with Average Frequency 1 per 2 years Regressed Volume is 327,000 Duration Bound is 29											
High Flow Pulses	Qp: 22,200 cfs with Average Frequency 1 per year Regressed Volume is 203,000 Duration Bound is 24											
	Qp: 3,230 cfs with Average Frequency 1 per season Regressed Volume is 22,600 Duration Bound is 13				Qp: 13,400 cfs with Average Frequency 1 per season Regressed Volume is 109,000 Duration Bound is 19				Qp: 7,760 cfs with Average Frequency 1 per season Regressed Volume is 62,500 Duration Bound is 17			
	Qp: 1,700 cfs with Average Frequency 2 per season Regressed Volume is 10,800 Duration Bound is 10				Qp: 6,480 cfs with Average Frequency 2 per season Regressed Volume is 46,700 Duration Bound is 14				Qp: 3,090 cfs with Average Frequency 2 per season Regressed Volume is 21,200 Duration Bound is 12			
	Qp: 930 cfs with Average Frequency 4 per season Regressed Volume is 5,400 Duration Bound is 8				Qp: 2,350 cfs with Average Frequency 4 per season Regressed Volume is 14,300 Duration Bound is 10				Qp: 1,320 cfs with Average Frequency 4 per season Regressed Volume is 7,830 Duration Bound is 8			
Base Flows (cfs)	160				170				160			
	77				92				70			
	42				47				37			
Subsistence Flows (cfs)	16				16				16			
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
	Winter				Spring				Summer			

Base Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 180 cfs, or when the flow is below 920 cfs and the flow drops from one day to the next by less than 5%.

BRGlenRose19242010

Brazos River Authority

	System Permit	BBEST
Period of Record	Pre-Reservoir	Full Period of Record
Subsistence	7Q2	Q95
Base Statistics	Quartile	Quartile
Seasons	4 three-month	3 four-month
Hydrologic Condition	Reservoir Storage • Base Flow • Pulse	Palmer Hydrologic Drought Index • Base Flow only
Pulse Frequency	Quartile	Predetermined, not computed
Pulse Peak Flow	Quartile	Frequency of Occurrence
Pulse Volume	Quartile	Central Tendency of Regressed Volume
Pulse Duration	Quartile	Upper Bound of Regressed Duration
Overbank Flow	1.5 year event, Not Included	NWS Flood Stage, Recommended
Initiate Pulse	Daily Flow Increase 50%	Pulse Peak Flow Target
Terminate Pulse	• Peak, Volume **and** Duration • Daily Flow Decrease 5% • Flow 10th Percentile	• Peak, Volume **or** Duration • Daily Flow Decrease 5% • Flow Target
Non-Qualifying Pulse Event	Additional Pulse Required to Meet Volume and Duration to Qualify Toward Frequency	Each Pulse Events that Meet Pulse Peak Qualifies Toward Frequency

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Questions?

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Backup Slides

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Modified Recommendation at Glen Rose

Overbank Events												
High Flow Pulses	Qp: 22,200 cfs with Average Frequency 1 per year Regressed Volume is 203,000 Duration Bound is 24											
	Qp: 3,230 cfs with Average Frequency 1 per season Regressed Volume is 22,600 Duration Bound is 13				Qp: 13,400 cfs with Average Frequency 1 per season Regressed Volume is 109,000 Duration Bound is 19				Qp: 7,760 cfs with Average Frequency 1 per season Regressed Volume is 62,500 Duration Bound is 17			
	Qp: 1,700 cfs with Average Frequency 2 per season Regressed Volume is 10,800 Duration Bound is 10				Qp: 6,480 cfs with Average Frequency 2 per season Regressed Volume is 46,700 Duration Bound is 14				Qp: 3,090 cfs with Average Frequency 2 per season Regressed Volume is 21,200 Duration Bound is 12			
Base Flows (cfs)	160				170				160			
	77				92				70			
	42				47				37			
Subsistence Flows (cfs)	16				16				16			
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
	Winter				Spring				Summer			

Base Flow Levels	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)

Pulse volumes are in units of acre-feet and durations are in days.

Period of record used : 1/1/1924 to 12/31/2010.

Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 180 cfs, or when the flow is below 920 cfs and the flow drops from one day to the next by less than 5%.

NWS Action Stage 22.0 ft = 29,500 cfs

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Glen Rose Stream Gage - DRAFT EFS based on CRR template

		Winter (Nov–Feb)	Spring (Mar–Jun)	Summer (Jul–Oct)
High Flow Pulses	**Wet**	Qp: 1,700 cfs with Average Frequency 1 per Season Regressed Volume is 10,800 Duration Bound is 10	Qp: 6,480 cfs with Average Frequency 1 per Season Regressed Volume is 46,700 Duration Bound is 14	Qp: 3,090 cfs with Average Frequency 1 per Season Regressed Volume is 21,200 Duration Bound is 12
	Avg	Qp: 930 cfs with Average Frequency 2 per Season Regressed Volume is 5,400 Duration Bound is 8	Qp: 2,350 cfs with Average Frequency 2 per Season Regressed Volume is 14,300 Duration Bound is 10	Qp: 1,320 cfs with Average Frequency 2 per Season Regressed Volume is 7,830 Duration Bound is 8
	Dry	Qp: 930 cfs with Average Frequency 1 per Season Regressed Volume is 5,400 Duration Bound is 8	Qp: 2,350 cfs with Average Frequency 1 per Season Regressed Volume is 14,300 Duration Bound is 10	Qp: 1,320 cfs with Average Frequency 1 per Season Regressed Volume is 7,830 Duration Bound is 8
Base Flows (cfs)	**Wet**	160	170	160
	Avg	77	92	70
	Dry	42	47	37
Subsistence Flows (cfs)		16	16	16

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Winter				Spring				Summer			

Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)

Notes:

1. Period of Record used : 1/1/1924 to 12/31/2010.
2. Volumes are in acre-feet and durations are in days.
3. Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 180 cfs, or when the flow is below 920 cfs and the flow drops from one day to the next by less than 5%.
4. 50% rule applied as defined by BBASC
5. Wet, Average, Dry defined by hydrologic season.

Palo Pinto Stream Gage - DRAFT EFS based on CRR template

		Winter (Nov, Dec, Jan, Feb)	Spring (Mar, Apr, May, Jun)	Summer (Jul, Aug, Sep, Oct)
High Flow Pulses	Wet	Qp: 1,390 cfs with Average Frequency 1 per Season Regressed Volume is 7,180 Duration Bound is 7	Qp: 3,370 cfs with Average Frequency 1 per Season Regressed Volume is 20,200 Duration Bound is 10	Qp: 2,260 cfs with Average Frequency 1 per Season Regressed Volume is 13,000 Duration Bound is 9
	Avg	Qp: 850 cfs with Average Frequency 2 per Season Regressed Volume is 3,690 Duration Bound is 5	Qp: 1,400 cfs with Average Frequency 2 per Season Regressed Volume is 6,600 Duration Bound is 6	Qp: 1,230 cfs with Average Frequency 2 per Season Regressed Volume is 5,920 Duration Bound is 6
	Dry	Qp: 850 cfs with Average Frequency 1 per Season Regressed Volume is 3,690 Duration Bound is 5	Qp: 1,400 cfs with Average Frequency 1 per Season Regressed Volume is 6,600 Duration Bound is 6	Qp: 1,230 cfs with Average Frequency 1 per Season Regressed Volume is 5,920 Duration Bound is 6
Base Flows (cfs)	Wet	100	120	120
	Avg	61	75	72
	Dry	40	39	40
Subsistence Flows (cfs)		17	17	17

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Winter				Spring				Summer			

Flow Levels	
	High (75th %ile)
	Medium (50th %ile)
	Low (25th %ile)

Notes:

1. Period of Record used : 1/1/1925 to 12/31/2010.
2. Volumes are in acre-feet and durations are in days.
3. Episodic events are terminated when the volume or duration criteria are met, or when the flow drops below 169 cfs, or when the flow is below 693 cfs and the flow drops from one day to the next by less than 5%.
4. 50% rule applied as defined by BBASC
5. Wet, Average, Dry defined by hydrologic season.